Microwave Kinetic Inductance Detectors and Their Implications for Dark Energy

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Abstract

Microwave kinetic inductance detectors (MKIDs) are superconducting photon detectors first developed at the California Institute of Technology and NASA's Jet Propulsion Laboratory in 2003, by Drs. Jonas Zmuidzinas and Rick LeDuc. Fermilab is collaborating with the University of California, Santa Barbara on the research and development of these detectors. MKIDs have time resolution capabilities and are able to identify the energy of individual photons. To fully understand and characterize the properties of the MKID device, tests were run using different wavelengths of light, changing the temperature of the cryogenic refrigerator, and analyzing the critical temperature from a plot of frequency versus temperature. Observations were performed using wavelengths between 360 and 700 nm. To find the critical temperature of each pixel, wide sweep scans were taken of the detector at different temperatures, beginning at 60 mK and ending at 223 mK. The data from the wide sweep was then plotted on a graph of temperature versus frequency and fit to an equation that included both variables. After fitting the data from the plot, the critical temperature of each pixel was extrapolated from the data. After fitting the graph, it was found that the critical temperature is the same for every pixel on the device. Promising results reaffirm the potential of the MKID detectors. Improving the MKIDs and understanding how they work aids the effort to make them operational. Moving forward, it is the goal of Fermilab to use the MKID detectors in combination with the Dark Energy Camera to further explore the universe and effectively measure the redshift of the galaxies.